

# **Ninth Regional Wetland and Water Resources Meeting**

## ***Cumulative Risk Index Analysis (CRIA)***

**Gerald R. Carney, Ph.D.**  
**Toxicologist , Region 6 U. S. EPA**  
**[carney.gerald@epa.gov](mailto:carney.gerald@epa.gov)**

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# Cumulative Risk Thinking

## Lessons Learned on Planning and Scoping for Environmental Risk Assessments

» U.S. EPA, Science Policy Council Draft Document, November 15, 2001

- Consideration of Cumulative Impacts In EPA Review of NEPA Documents

» U.S. EPA, EPA 315-R-99-002, May 1999

- Framework for Cumulative Risk Assessment (CAFO Example) draft

<http://epa.gov/ncea/raf/frmwrkcra.htm>

- $$\text{CRIA} = \frac{\text{Watershed Unit Sub area}}{(\text{Total Affected Area} \div \text{Watershed area})} \times \text{Degree of Vulnerability (scale of 1-5)} \times \text{Degree of Impact (scale of 1-4)}$$
- CRIA System Criteria Library (approximately 90 ever evolving indicators in Region 6 GIS)

# Planning and Scoping Process

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- Defining the stressors (chemical, physical, biological)
- Sources of environmental stress
- Affected populations (workers, residents, wildlife, economic stakeholders)
- Pathways (human health, ecological)
- Temporal considerations (short and long term impacts)

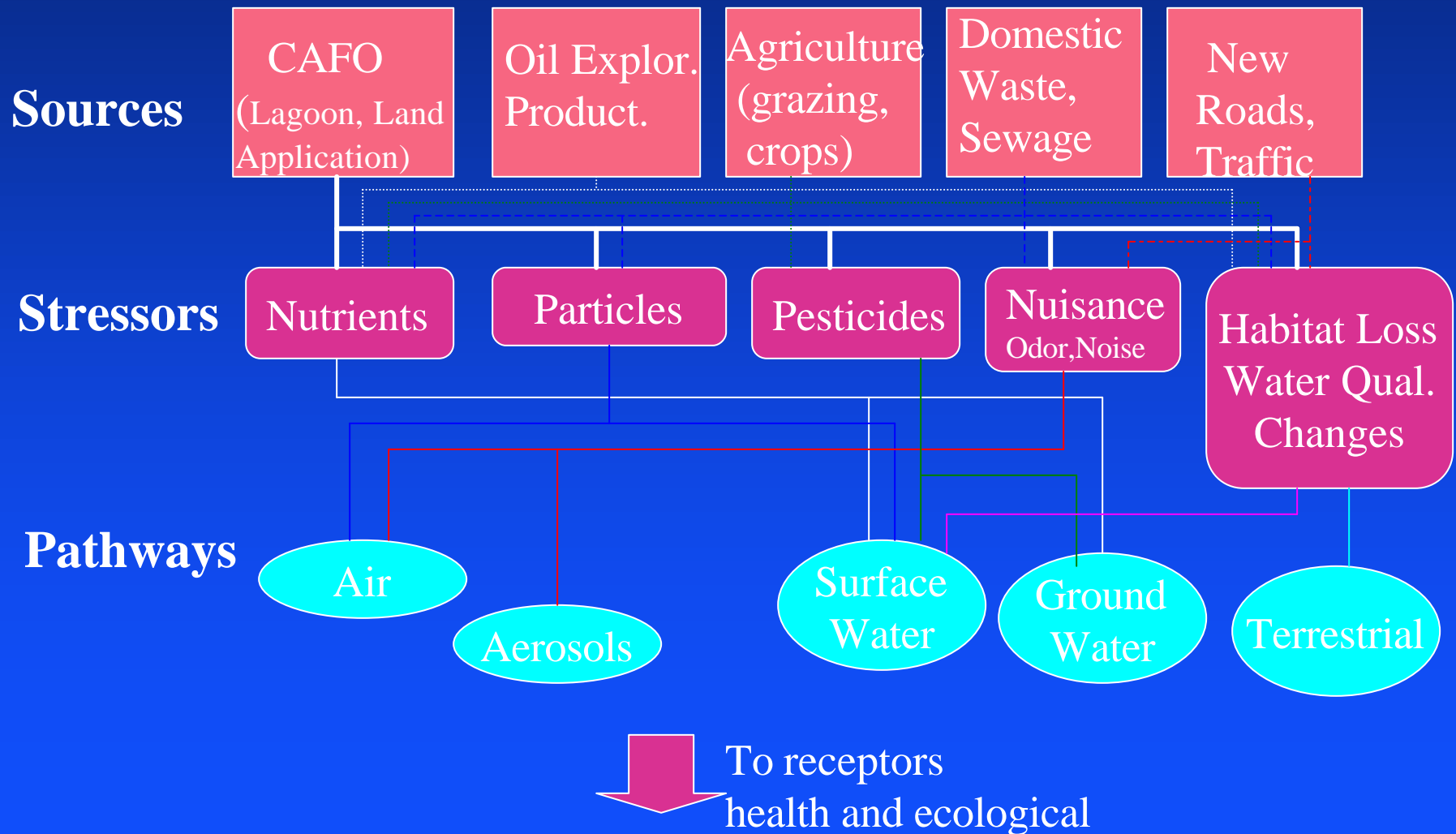
# The Conceptual Model

- Always a good first step.

Example: Confined Animal Feeding Operation (CAFO)

- Purpose: Determine impacts related to CAFOs construction and operation.
- Scope: Watershed – or individual CAFO sites (distances from lagoons, land application areas, barns, roads).
- Technical Approach:  
GIS / CRIA system approach using landscape, hydrologic, air , ecological, socio-economic and other appropriate analyses.

# Watershed Preliminary Conceptual Model



# REGION 6 RISK CHARACTERIZATION IMPLEMENTATION PLAN

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- Region 6 Risk Activities (p.11)
  - - Category I: Screening, modeling, CRIA, EJI, HRI, multi-media enforcement targeting.
  - - Category II: Intermediate level, some monitoring, sampling, supported by Regional guidance, permit related
  - - Category III: Superfund / RCRA baseline, Agency regulations / national guidance, extensive sampling

# Using a Screening Approach to Assess Cumulative Risk

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- Watersheds defined spatial components (additive indicator judgments and areas)
- Points or polygons defining the industry
- Vulnerability criteria: indicators with ranked (1 – 5 scaled) judgments as to environmental concern
- 
- Impact criteria: 1 – 5 scaled indicators judging stressors presented by CAFO operations

# **Watershed Vulnerability Assessment Endpoints**

- Geology rating
- Rainfall
- Surface water use
- Near residents
- Other industries
- Protected lands
- Water quality
- Road Density
- Wildlife Habitat quality
- Habitat quantity
- Habitat Fragmentation
- Aquifer Rating
- Septic tanks
- Animal units
- Soil permeability
- Nitrates
- Economic status
- Water quantity
- Distance to water
- Other CAFOs
- Stream Flow
- Air Quality
- Ground Water Depth (probability, some measurements)
- TRI Releases to water
- Drinking water wells
- Oil and gas wells



# Watershed Vulnerability Assessment Endpoints

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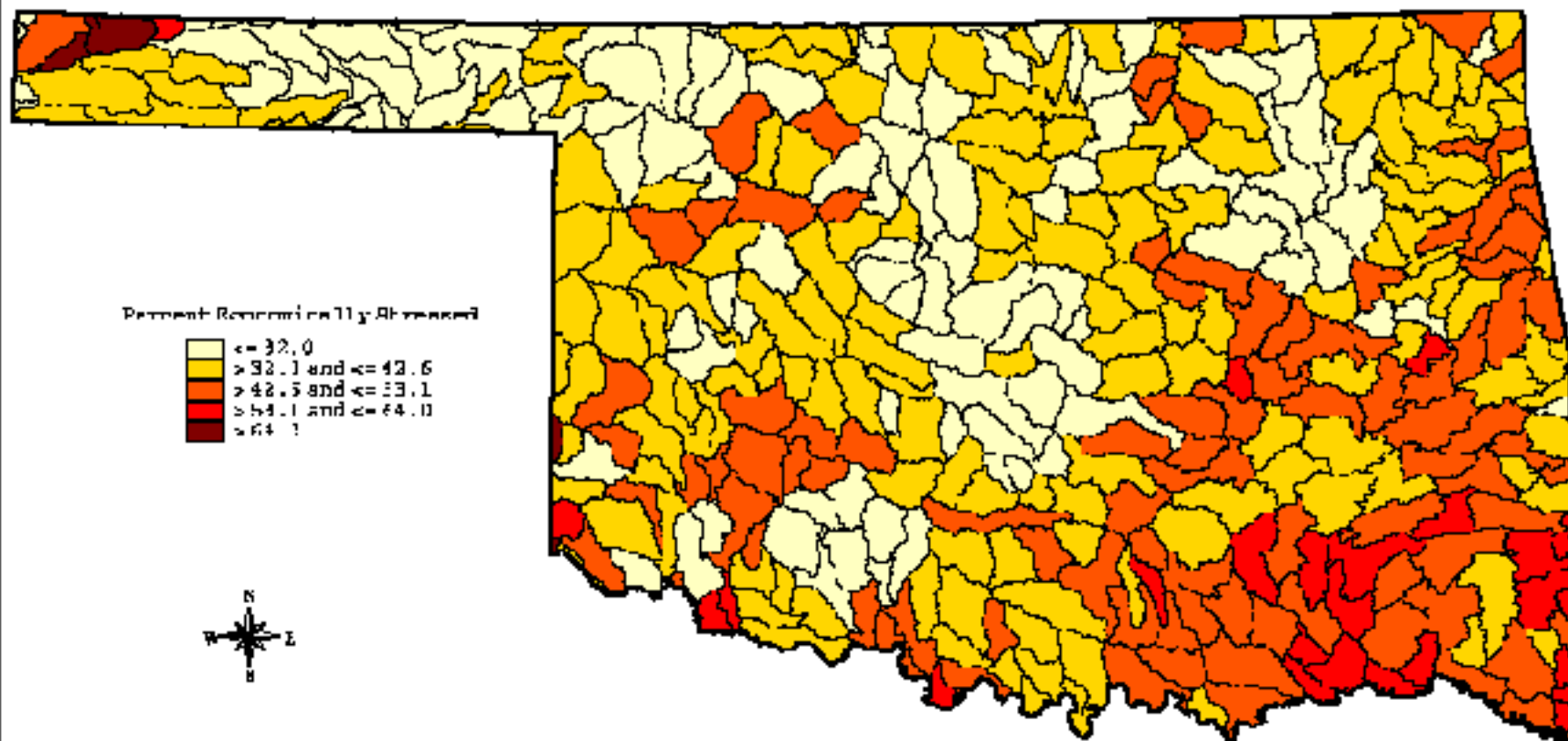
- Habitat Fragmentation (area to perimeter ratio) and quality
- Roads (particulates, accidents, spillage, fragmentation, urbanization))
- Other land use related pollution sources (landfills, crop land, pasture, oil fields, urban runoff, animal waste)
- Flood plains
- Air quality (Particulates, NO<sub>x</sub>, SO<sub>x</sub>, CO, VOCs, Ozone)

# GIS Cumulative Risk Screening System

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- Allows us to do more ... (60 - 90 indicators can be evaluated for several sites in 2 hours)
- Modular Approach: All criteria are mathematically related, can be combined to meet cumulative program assessment needs
- Strengthens the environmental assessment process (peer reviewed, consistent methods, use of EPA and other agency data)

# Confined Animal Feeding Operations Oklahoma Percent Economically Stressed



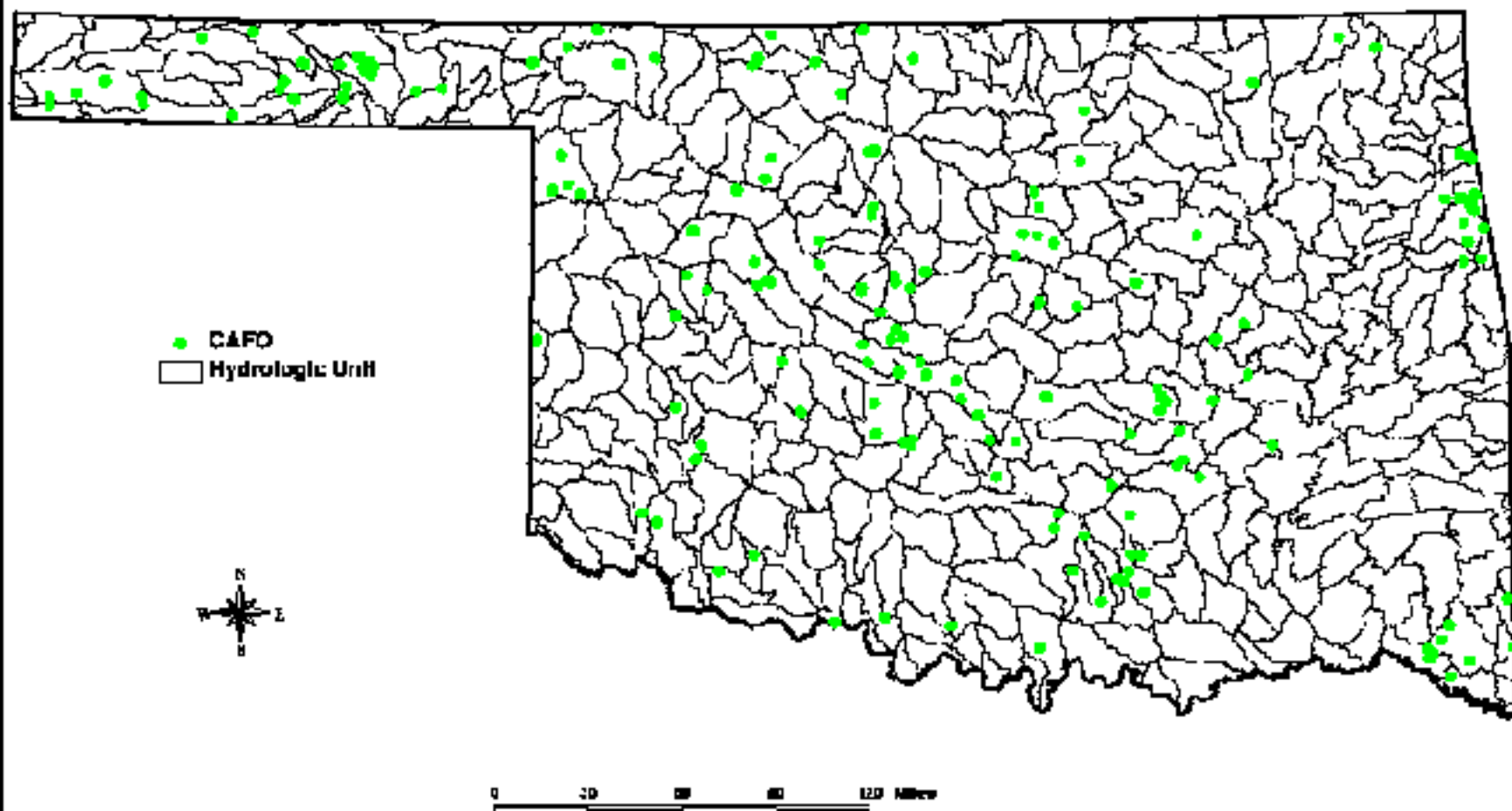
Map Created: September 1, 1998

Source:  
Agriculture: Unit boundaries are from the 1992 U.S. Census.  
Percent Economically Stressed: calculated using 1992-94 data from the U.S. Bureau of the Census, 1992.

U.S. EPA  
Region 6  
CAG Support  
Dallas, TX



## Confined Animal Feeding Operations Oklahoma



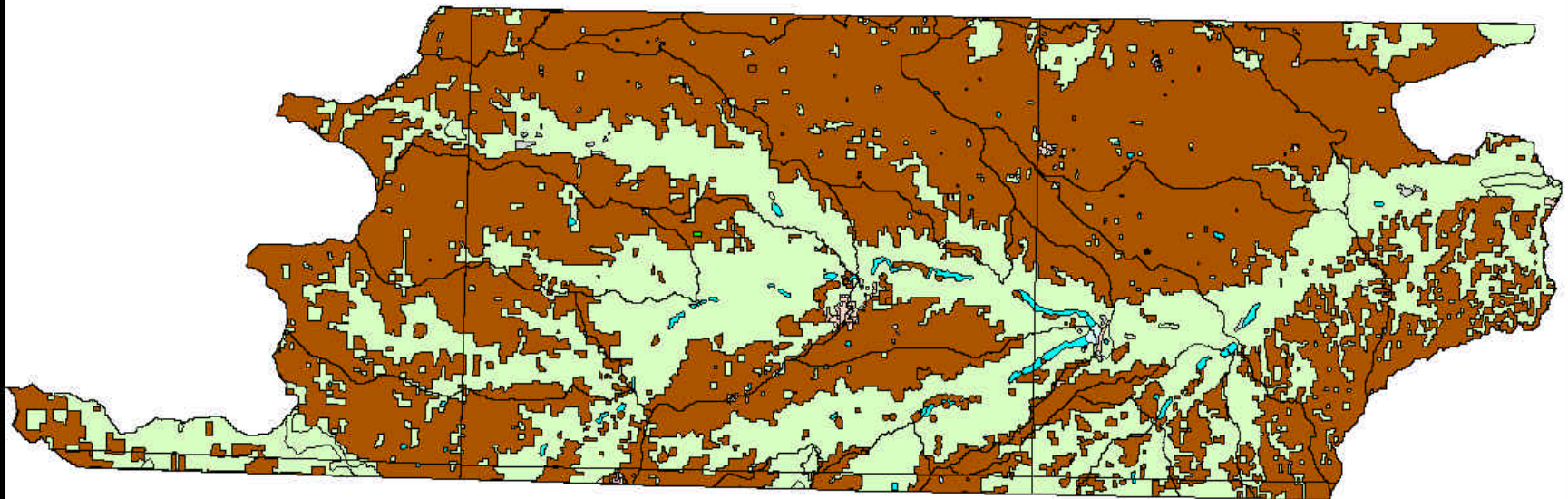
Map Created: November 19, 1999

Source:  
CAFO locations are from U.S. EPA Region 6, Dallas.  
Hydrologic Unit boundaries are from the USGS, Oklahoma City.

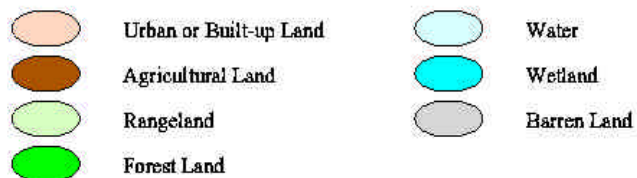
U.S. EPA  
Region 6  
CWS Report  
Dallas, TX



## Land Use/Land Cover Texas County, OK Watersheds



### Land Use/Land Cover

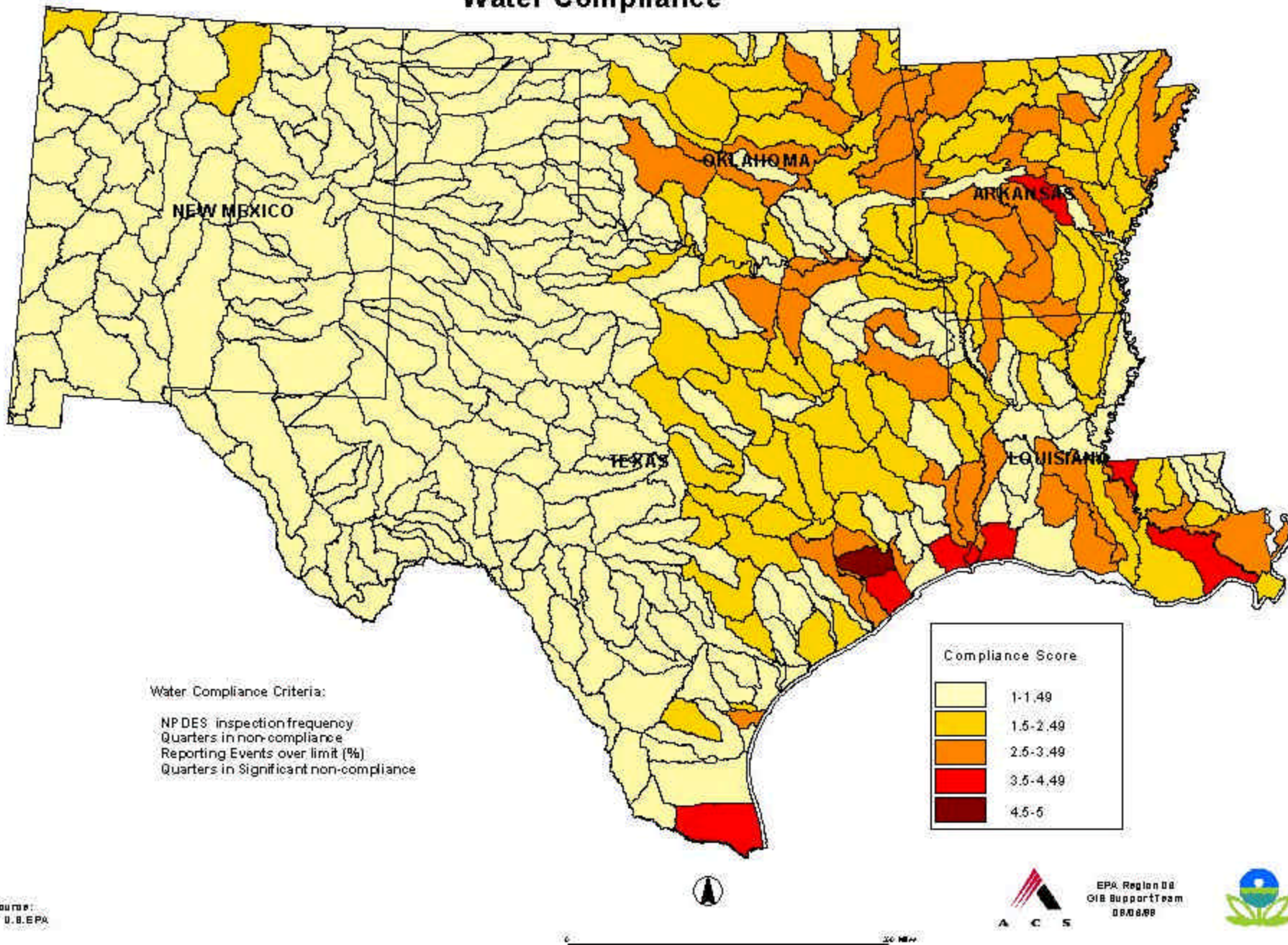


0 10 20 30 40 Miles





# 2000 Multimedia Enforcement Targeting Water Compliance

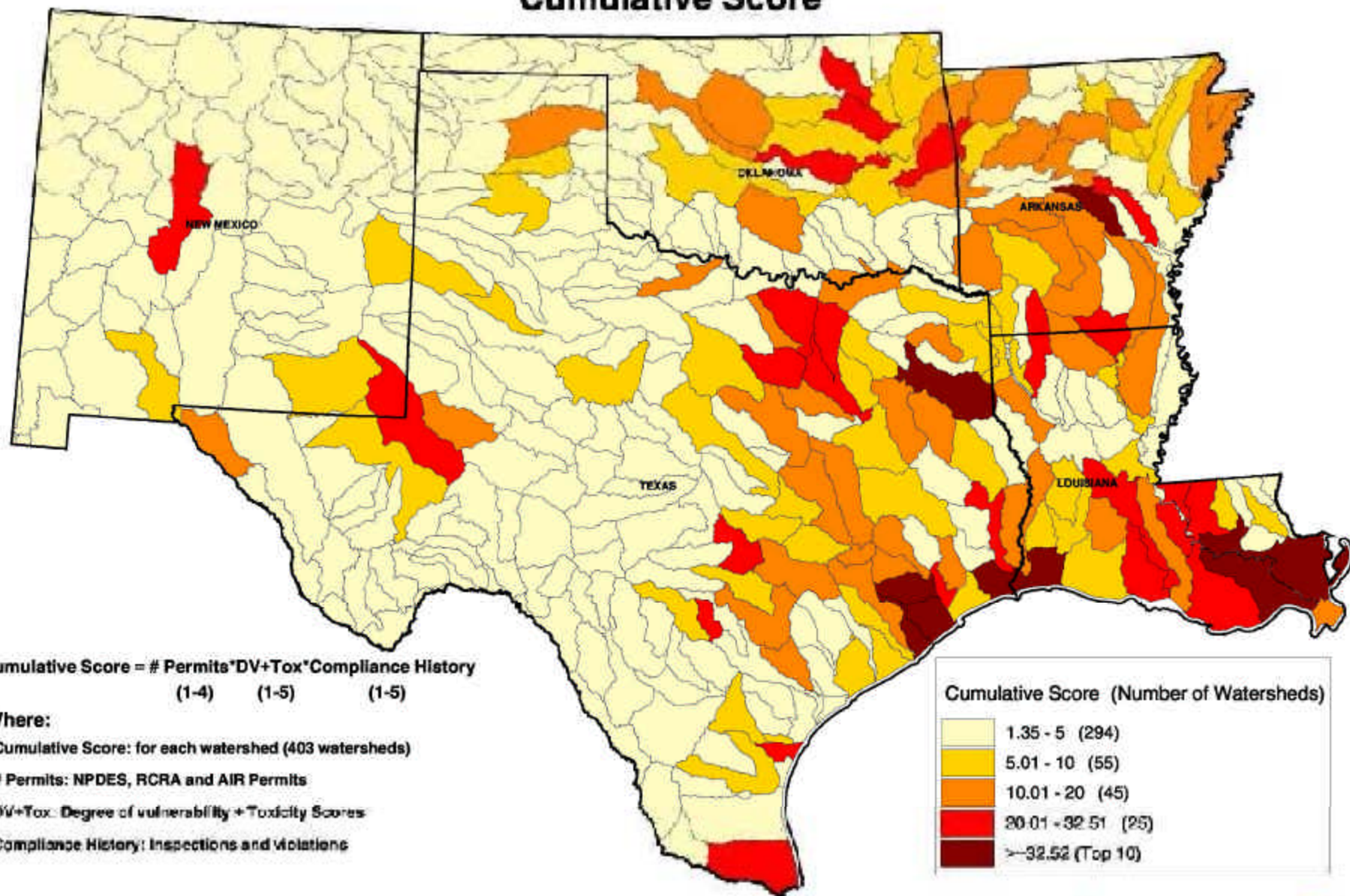


# Water Compliance History

- Days from last inspection (<6 mos.=1, >2 yrs. or no data=5)
- Non-Compliant Qtrs (0 or ND=1, 7 to 8 Qtrs=5)
- Significant Non-Compliance Qtrs (0 or ND=1, 7 to 8 Qtrs=5)
- Percent Reporting Events (<6 mos.=1, >2 yrs. or no record=5)
- Watershed Score (sum of criteria rank scores)



# 2000 Multimedia Enforcement Targeting Cumulative Score

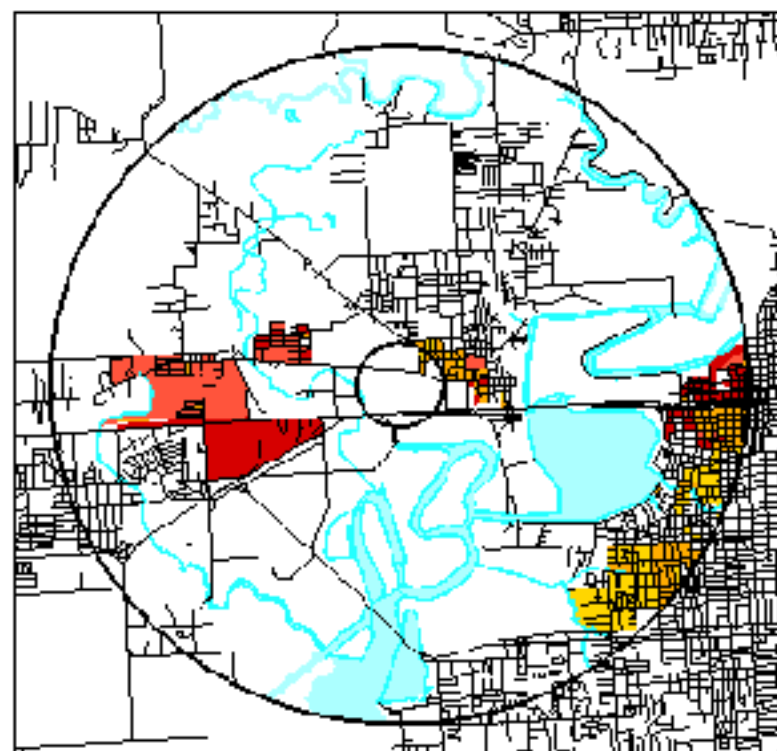




RANK	HUCNAME	FAC_R	DVTOX	CIV_S	FINAL
Hou/TX 1	BUFFALO-SAN JACINTO	4	4.06	5.00	81.20
Hou/TX 2	WEST GALVESTON BAY	4	3.58	4.07	58.28
SE/LA 3	EAST CENTRAL LOUISIANA COASTAL	4	3.63	4.00	58.08
SE/TX 4	SABINE LAKE	4	3.54	3.60	50.98
SE/LA 5	EASTERN LOUISIANA COASTAL	3	3.59	3.40	36.62
E/TX 6	MIDDLE SABINE	3	3.26	3.55	34.72
SW/LA 7	LOWER CALCASIEU	3	3.46	3.27	33.94
Hou/TX 8	AUSTIN-OYSTER	3	3.78	2.93	33.23
LR/AR 9	LOWER ARKANSAS-MAUMELLE	3	3.17	3.48	33.09
SE/LA 10	LAKE MAUREPAS	3	3.83	2.83	32.52
E/TX 11	LOWER WEST FORK TRINITY	3	3.09	3.38	31.33
BR/LA 12	AMITE	3	3.44	2.98	30.75
NE/TX 13	ELM FORK TRINITY	3	3.09	3.27	30.31
BR/LA 14	BAYOU SARA-THOMPSON	3	3.96	2.53	30.06
NC/TX 15	UPPER TRINITY	3	3.13	3.13	29.39
LA 16	VERMILION	3	2.88	3.33	28.77
SE/TX 17	LOWER NECHES	3	3.45	2.77	28.67
S/TX 18	SOUTH CORPUS CHRISTI BAY	3	3.21	2.87	27.64
S/TX 19	SOUTH LAGUNA MADRE	3	3.19	2.87	27.47

# CONOCO Lake Charles Refinery, Lake Charles - Calcasieu Parish, LA

## Economic Status - Degree of Vulnerability (DVECO)



Longitude: -93 15 14 Latitude: 30 14 30



Percent Economically Stressed  
by Census Block Group  
State Percentage - 95.9

- ≤ the State Percentage
- > the State Percentage,  
≤ 1.33 times the State Percentage
- > 1.33 times the State Percentage,  
≤ 1.66 times the State Percentage
- > 1.66 times the State Percentage,  
≤ 2 times the State Percentage
- > 2 times the State Percentage



Potential Environmental  
Justice Index for  
Two Study Areas

	1 Sq. Mile	50 Sq. Mile
Total Population	249	28097
Population Farmland (PF)	2	2
Percent Minority	38.9%	29.6%
Minority Status (DVMAY)	2	1
Percent Economically Stressed	47.6%	32.5%
Economic Status (DVECO)	2	1
Environmental Justice Index	8	2

Data Sources and References: US Bureau of the Census, 1990 PLS4-131 and STPSA Data, and TIGER Files  
US EPA Region 8, 1992. Computer Assisted Environmental Assessment, Methodologies, Chapter V. Special Applications,  
Environmental Equity, Planning and Analysis Section, Management Division, Region 8 EPA, Dallas, Texas



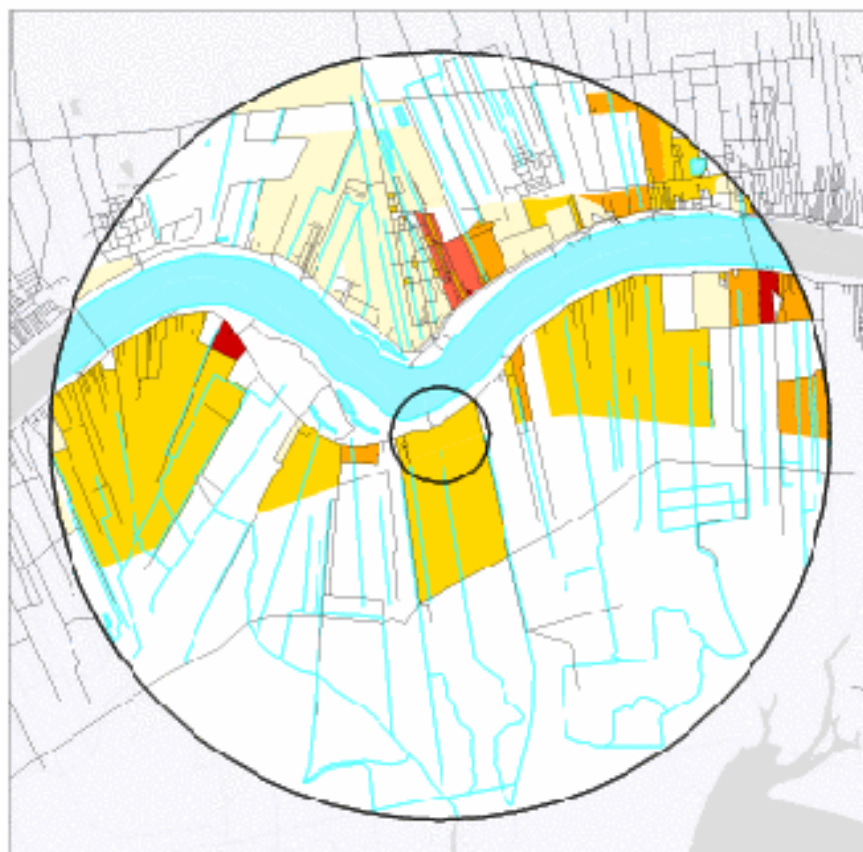
## Example 1: Wallace, Louisiana – NEPA EIS Site Rural Area Along Mississippi River

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- Proposed site for building a new Factory.
- Low population, mostly farm land.
- High percent minority.
- Slightly lower annual income than state average.
- Culture change considerations (farm to industry).
- Very large wetland areas restricting population growth and movement.
- Recreational and subsistence value to preservation of ecology.
- Increased shipping and truck traffic possible.

# EIS Site, Wallac, Wallace, LA

## Economic Status - Degree of Vulnerability (DVECO)



Longitude: -90 37 0 Latitude: 30 1 29



Percent Economically Stressed  
by Census Block Group  
State Percentage = 36.3

- ≤ the State Percentage
- > the State Percentage,  
≤ 1.33 times the State Percentage
- > 1.33 times the State Percentage,  
≤ 1.66 times the State Percentage
- > 1.66 times the State Percentage,  
≤ 2 times the State Percentage
- > 2 times the State Percentage



Potential Environmental  
Justice Index for  
Two Study Areas

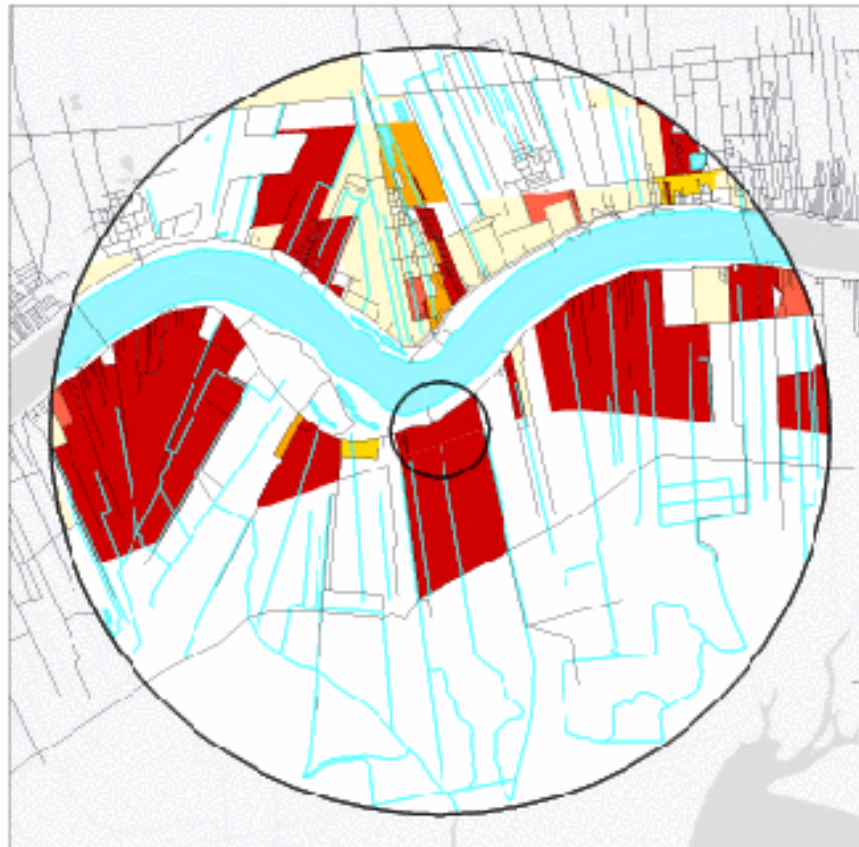
	1 Sq. Mile	50 Sq. Mile
Total Population	134	3446
Population Ranking (PF)	1	1
Percent Minority	100%	67.7%
Minority Status (DVMAV)	5	4
Percent Economically Stressed	39.5%	42%
Economic Status (DVECO)	2	2
Environmental Justice Index	10	8

Data Sources and References: US Bureau of the Census, 1990 PL94-171 and STF9A Data, and TIGER Files  
US EPA Region 6, 1992. Computer Assisted Environmental Assessment: Methodologies, Chapter V. Special Applications,  
Environmental Equity. Planning and Analysis Section, Management Division, Region 6 EPA, Dallas, Texas



# EIS Site, Wallac, Wallace, LA

## Minority Status - Degree of Vulnerability (DVMAV)



Percent Minority by Census Block  
State Percentage = 34.2

- ≤ the State Percentage
- > the State Percentage,  
≤ 1.33 times the State Percentage
- > 1.33 times the State Percentage,  
≤ 1.66 times the State Percentage
- > 1.66 times the State Percentage,  
≤ 2 times the State Percentage
- > 2 times the State Percentage



Potential Environmental  
Justice Index for  
Two Study Areas

	1 Sq. Mile	50 Sq. Mile
Total Population	134	3446
Population Ranking (PF)	1	1
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Data Sources and References: US Bureau of the Census, 1990 PL94-171 and STF9A Data, and TIGER Files  
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## Example 7: Houston Scrap High Environmental Justice Concern Area

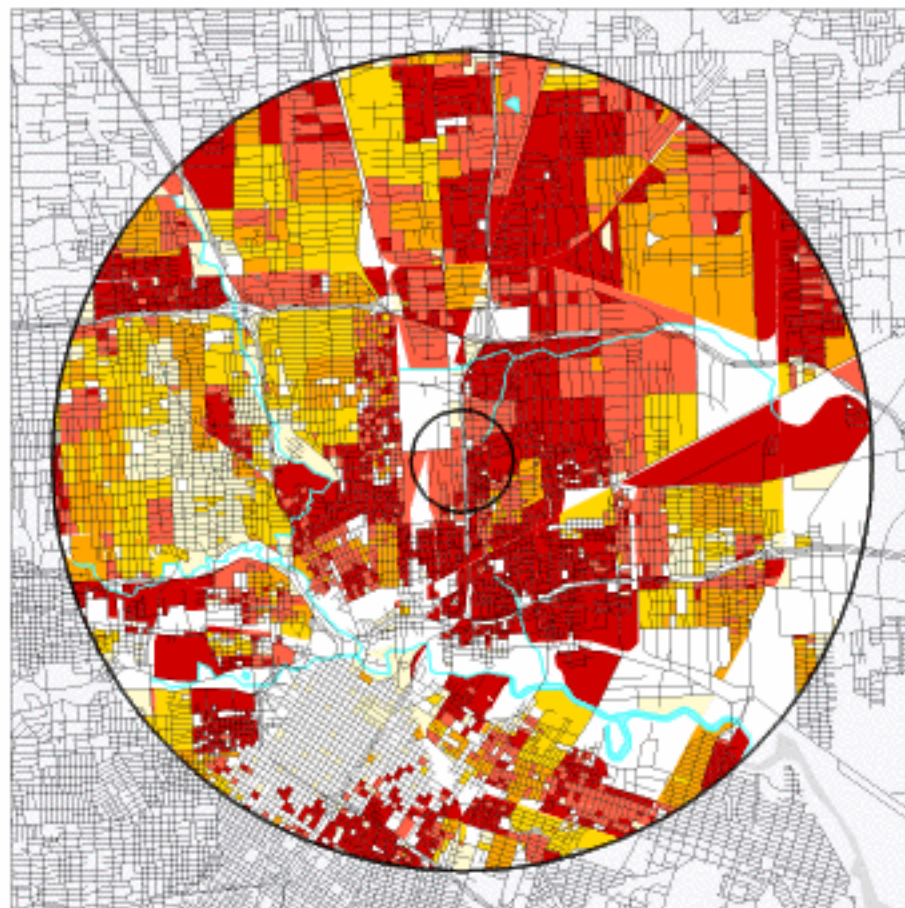
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- **Densely populated urban area (1 and 4 mile areas ranked a 3 on a 0-4 scale).**
- **High minority areas (99.3% in 1 mile radius and 85.2% in 4 mile radius)**
- **High number of economically stressed residents (55.3% and 48.1% for 1 and 4 mile areas respectively).**
- **High index rankings for both the 1 and 4 mile radii (75 and 60 scores).**



# Houston Scra, Harris, TX

## Economic Status - Degree of Vulnerability (DVECO)



Longitude: -95 20 24 Latitude: 29 47 30



**Percent Economically Stressed  
by Census Block Group  
State Percentage = 27.6**

- $\leq$  the State Percentage
- $>$  the State Percentage,  
 $\leq$  1.33 times the State Percentage
- $>$  1.33 times the State Percentage,  
 $\leq$  1.66 times the State Percentage
- $>$  1.66 times the State Percentage,  
 $\leq$  2 times the State Percentage
- $>$  2 times the State Percentage



**Potential Environmental  
Justice Index for  
Two Study Areas**

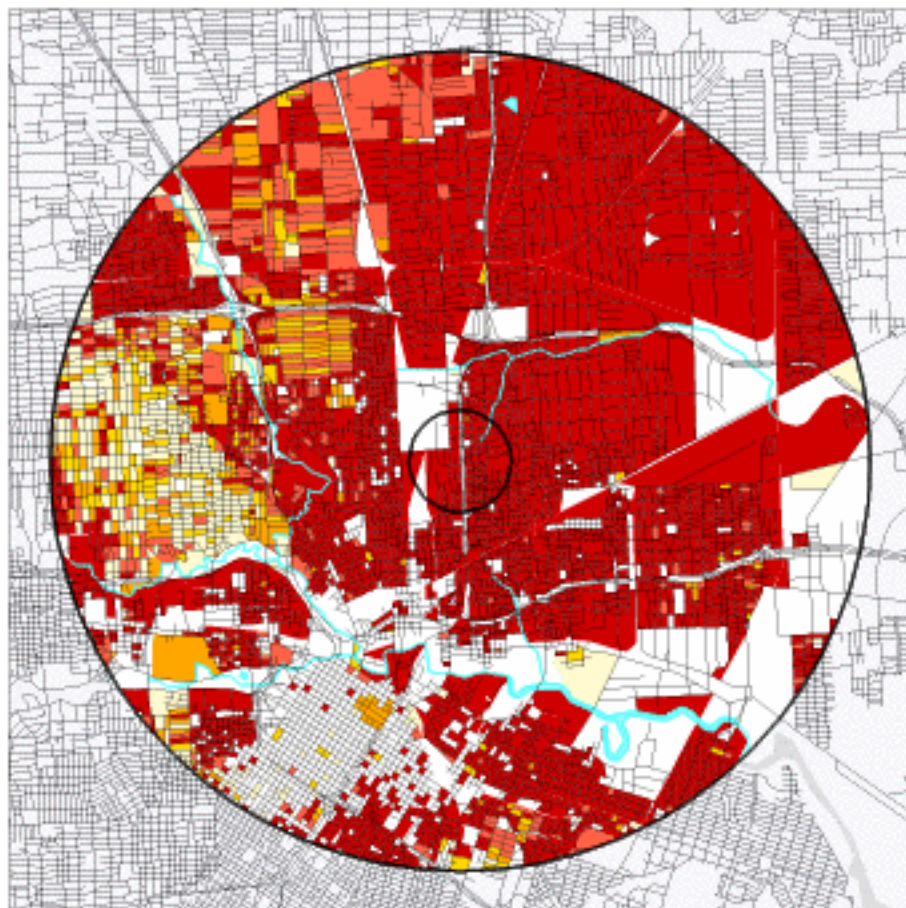
	1 Sq. Mile	50 Sq. Mile
Total Population	4010	208386
Population Ranking (PF)	3	3
Percent Minority	99.3%	85.2%
Minority Status (DVMAV)	5	5
Percent Economically Stressed	55.3%	48.1%
Economic Status (DVECO)	5	4
Environmental Justice Index	75	60

Data Sources and References: US Bureau of the Census, 1990 PL94-171 and STF3A Data, and TIGER Files  
US EPA Region 6, 1992. Computer Assisted Environmental Assessment Methodologies, Chapter V. Special Applications,  
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# Houston Scra, Harris, TX

## Minority Status - Degree of Vulnerability (DVMAV)



Longitude: -95 20 24 Latitude: 29 47 30



Percent Minority by Census Block  
State Percentage = 39.4

- ≤ the State Percentage
- > the State Percentage,  
≤ 1.33 times the State Percentage
- > 1.33 times the State Percentage,  
≤ 1.66 times the State Percentage
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≤ 2 times the State Percentage
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Potential Environmental  
Justice Index for  
Two Study Areas

	1 Sq. Mile	50 Sq. Mile
Total Population	4010	208386
Population Ranking (PF)	3	3
Percent Minority	99.3%	85.2%
Minority Status (DVMAV)	5	5
Percent Economically Stressed	55.3%	48.1%
Economic Status (DVECO)	5	4
Environmental Justice Index	75	60

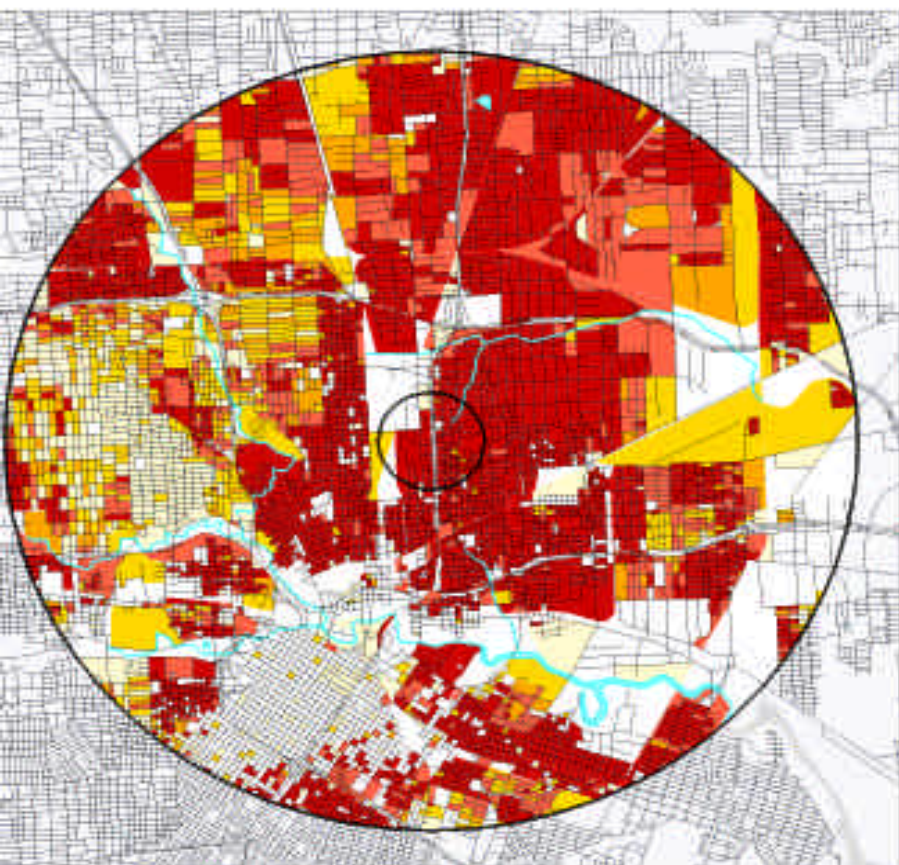
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# Houston Scra, Harris, TX

## Potential Environmental Justice Index (EJ)



Longitude: -95 20 24 Latitude: 29 47 30



Criteria Ranked by Census Block  
(DVMAV \* DVECO \* PF)

- 1 to 12
- 13 to 25
- 26 to 37
- 38 to 50
- 51 to 100



Potential Environmental  
Justice Index for  
Two Study Areas

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Total Population	4010	208386
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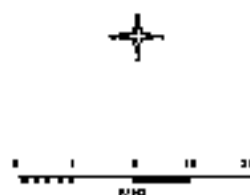
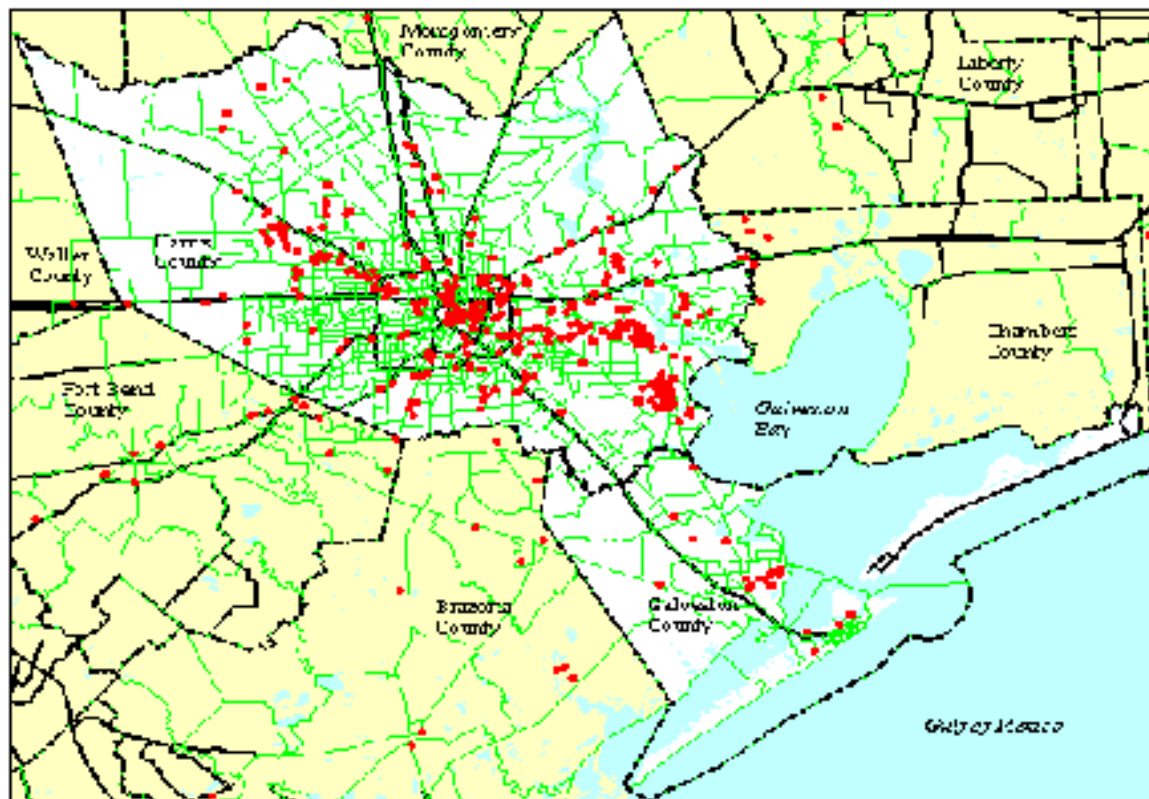


## Example 8: Houston – Galveston, Texas Screening Level Human Health Index Study

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- Over 400 Toxic Release Inventory (TRI) sites in the area.
- Each TRI chemical release was toxicologically assessed as to potential for health risk ( $\text{pounds released to air} \times \text{toxicity score} \times \text{bioaccumulation score}$ )
- Possible chemical release impacts for multiple facilities were assessed (4 mile radii around each TRI site).
- Health risk index and EJ Index scores were calculated.

# Community Based Multimedia Area Galveston/Harris Counties

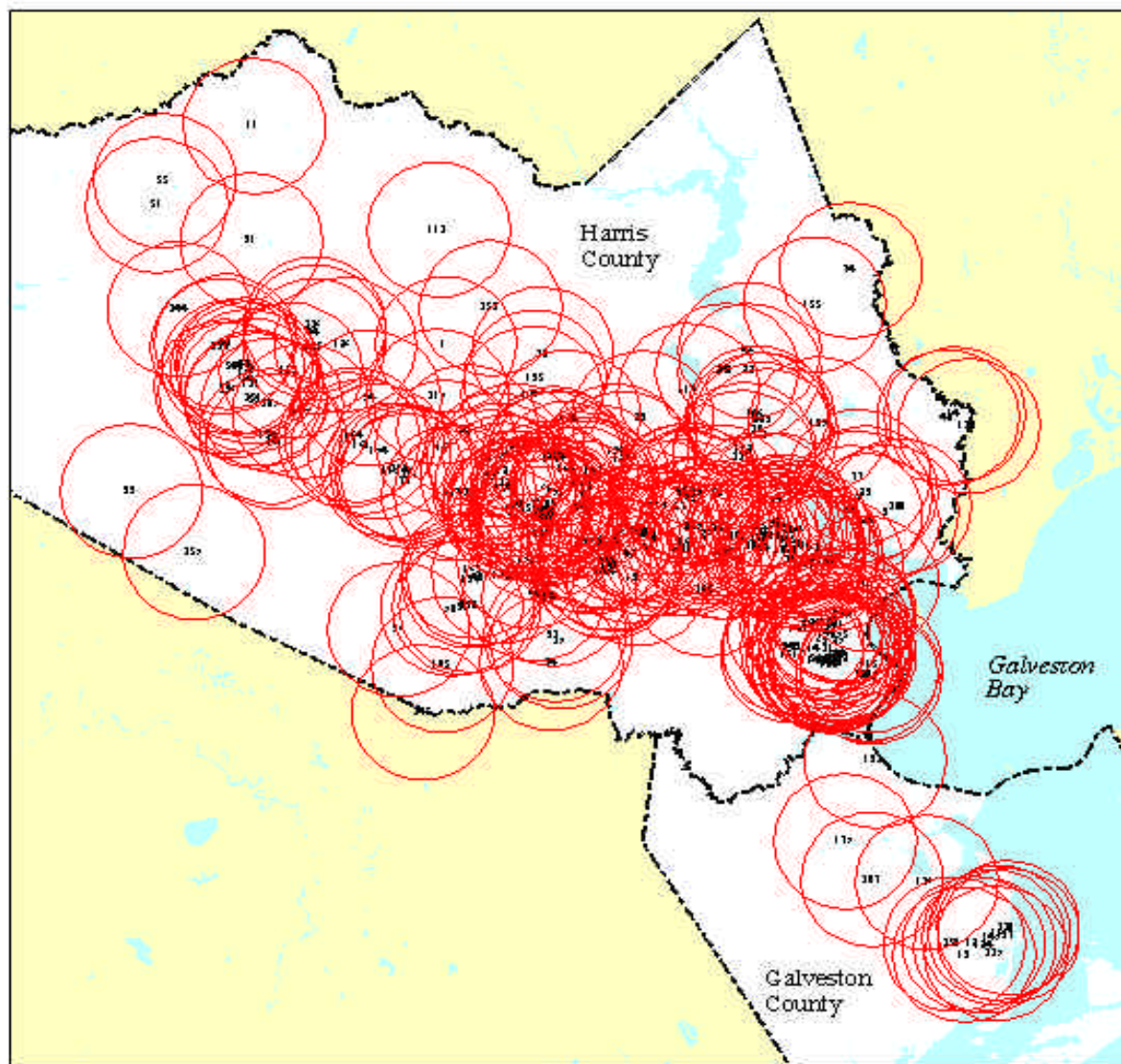


- Red dot: Community-based multimedia area
- Black line: Major Road
- Dashed line: County Boundary
- Blue area: Water





# COMMUNITY BASED ENVIRONMENTAL PROTECTION



RANK	HUCNAME	FAC_R	DVTOX	CIV_S	FINAL
Hou/TX 1	BUFFALO-SAN JACINTO	4	4.06	5.00	81.20
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S/TX 19	SOUTH LAGUNA MADRE	3	3.19	2.87	27.47

# Welcome to the 21st Century

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**Don't Breathe The Air**

**Don't Drink the Water**

**Don't Eat Fish, Sugar, Salts or Fats**

**Don't Have Sex Ever Again**